UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/016,619	12/06/2001	Stephen C. Netemeyer	PM 2000.062	6577

7590 07/27/2006

Gary D. Lawson
ExxonMobil Upstream Research Company
P.O. Box 2189
Houston, TX 77252-2189

EXAMINER	
PROCTOR, JASON SCOTT	
ART UNIT	**PAPER NUMBER**
2123	

DATE MAILED: 07/27/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)
	10/016,619	NETEMEYER ET AL.
	Examiner	Art Unit
	Jason Proctor	2123

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 May 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-13 and 16-28* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-13 and 16-28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *06 December 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Claims 1-13 and 16-22 were rejected in Final Office Action of 10 January 2006.

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 15 May 2006 has been entered.

Claims 1-13 and 16-28 are pending in this application. Claims 1-13 and 16-28 are rejected.

Duty to Disclose

A reference cited on form PTO-892, US Patent No. 6,052,520 to Watts, III, shares a common assignee with the instant application. This reference qualifies as prior art under 35 U.S.C. § 102(a) and therefore would not be excluded by the provisions of 35 U.S.C. § 103(c). This reference is relevant prior art but has not been submitted to the Office in an Information Disclosure Statement.

A reference cited on form PTO-892, "Reservoir Simulation: Past, Present, and Future" by J.W. Watts, SPE, Exxon Production Research Company, was discovered by reviewing the prosecution history of patent application 09/712,567 which issued as US Patent 6,928,399, assigned to ExxonMobil Upstream Research Company. None of these references have been cited in an Information Disclosure Statement.

In the interest of compact prosecution, the Examiner respectfully requests that Applicants consider the patent and non-patent literature known to and available to the persons identified in 37 CFR 1.56, which includes the assignee of the application, for the timely submission of potentially relevant prior art.

Claim Objections

1. Claim 5 is objected to for the use of parentheses in the phrase "wherein a text file (Data Definitions File) contains the definitions..." The use of parentheses in the claims is permitted to indicate reference numerals in the drawings. See MPEP 608.01(m). The meaning of the text "Data Definitions File" within parentheses is unknown. It is unclear whether this presents a claim limitation, defines a term, or holds some other meaning.

2. Claim 18 is objected to because the amendments to the claim do not comply with 37 CFR 1.121. Specifically, the amendment to claim 18 has deleted the phrase "and any combination thereof" but there are no markings in the claim listing. In the future, any amendments must fully comply with 37 CFR 1.121.

Appropriate correction is required.

Claim Interpretation

In the submission of 15 May 2006, Applicants reiterate certain arguments based on interpretations of the claim language which the Examiner has not and still does not find to be proper. Therefore, in the interest of compact prosecution, the Examiner explicitly sets forth what is believed to be a proper interpretation of the independent claims based on the plain and

ordinary meaning of the claim language. Applicants are invited to point out **specific** errors in these interpretations as expressly supported by the claim language, specification, or extrinsic evidence.

> Claim 1. A computer system comprising an object-oriented software product, the software product containing an object-oriented extensible class hierarchy for the storage of [*data*], the class hierarchy comprising a first set of generic classes representing a plurality of object types and a second set of generic classes representing member variables for the object types, [*the extensible class hierarchy permitting the addition of additional object types and additional member variables without any modifications to the class hierarchy itself*].

The phrase "for the storage of transport phenomena simulation data" is a statement of intended use that does not specifically define the invention. More specifically, "transport phenomena simulation data" is presumed to be, in the parlance of computer software, integers, floating precision numbers, bytes, characters, strings, and the like. A system that anticipates the claim as interpreted above, storing integers, floating precision numbers, bytes, characters, strings, and the like, anticipates a system that stores "transport phenomena simulation data" because the only distinguishing characteristic would be the intended use. The structure and functionality of the systems would be identical.

The phrase "the extensible class hierarchy permitting the addition of additional object types and additional member variables without any modifications to the class hierarchy itself" is

logically equivalent to "the extensible class hierarchy **does not prevent** the addition ..." This phrase **does not positively recite** features of the invention. This language **does not require** a step of "adding additional object types". This phrase is a **negative limitation**. Although a negative limitation is not indefinite *per se*, this negative limitation is indeed indefinite because it is unknown how a "hierarchy" would somehow prevent modifications to itself. It is not apparent that a hierarchy, i.e. an arrangement of data, can influence the actions of outside forces to prevent its manipulation. This language suffers additional deficiencies under 35 U.S.C. § 112, 1st paragraph, as described below. It is unknown what is meant by this language and therefore, for the purposes of examination, the claim is interpreted without this phrase.

The phrase "extensible" is defined as "Capable of being extended or protruded. Of or relating to a programming language or a system that can be modified by changing or adding features." (The American Heritage College Dictionary, Fourth Edition, 2004) The Examiner submits that **an object-oriented computer programming language class hierarchy is extensible** because one of the defining features of an object-oriented programming language is the ability to create new objects, i.e. add features.

For these reasons, the claim interpretation set forth above is a proper, reasonable, and broad interpretation of claim 1.

Claim 10. A computer-implemented method of simulating transport phenomena in a facility network that models facilities used in the production of hydrocarbons [*i.e., a "facility network" models facilities used in the production of hydrocarbons*], the method comprising the steps of:

Building a model comprising a facility network [*see above*] wherein the facility network comprises facility instances [*"facility instances" are "specified values of facility types," see below*] formed from facility types based on a first set of generic classes and member variable instances [*"member variable instances" are "specified values of member variables," see below*] formed from member variables for the facility types based on a second set of generic classes, and wherein the first and second set of generic classes are part of a class hierarchy that is not modified by the addition of other facility types and member variables [*i.e., the class hierarchy is what it is, and shall not be modified further*];

Specifying values of the member variables and the facility types for the facility network, wherein the specified values of the facility types form facility instances, the specified values of the member variables form member variable instances;

Using [*as a function of time, see below*] the facility instances and member variable instances in a mathematical simulation of transport phenomena within the facility network as a function of time; and

Predicting the behavior of the facilities based on the mathematical simulation.

For clarity of the official record, this claim appears to define "a first set of generic classes" upon which "facility types" are based. Specifying values of the facility types forms "facility instances". This claim appears to define "a second set of generic classes" upon which "member variables" are based. Specifying values of the member variables forms "member variable instances".

The phrase "the first and second generic classes are part of a class hierarchy that is not modified by the addition of other facility types and member variables" does not appear analogous to the "permitting" language recited by claim 1. Here, the claim neither recites any steps of adding other facility types or member variables, nor does the claim invoke the same "permitting" type language. Therefore the Examiner interprets this phrase as set forth above based on the plain meaning of the phrase "is not modified," as in, "This thing is original; it is not modified (by the addition of non-original features)." The phrase is therefore interpreted as set forth above.

Claim 13. A computer-implemented method of simulating transport phenomena in a model of a physical system [sic, *presumed to mean "simulating transport phenomena in a physical system using a model of said physical system"*], [*the physical system*] comprising a hydrocarbon-bearing reservoir penetrated by a plurality of wells, the plurality of wells connected to surface facilities, the method comprising:

Discretizing the model of the physical system into a plurality of volumetric cells, wherein each volumetric cell is modeled as a node, and adjacent nodes [*simulate the*] exchange [*of*] fluid through connections between the nodes;

Using facility instances and member variable instances of a class hierarchy to model the nodes and connections in the portion of the discretized model that represents wells and surface facilities of the physical system, wherein the class hierarchy comprises a first set of generic classes representing facility types utilized to create the facility instances and a second set of generic classes representing the member variables for the facility types

utilized to create the member variable instances, [*the class hierarchy [does not prevent] the addition of additional facility types and additional member variables without any modifications to the class hierarchy itself*];

Specifying geometric and transport properties for each node and connection;

Specifying initial conditions for each node and connection;

Simulating, as a function of time, the transport phenomena in the discretized physical system; and

Predicting the behavior of the physical system based on the simulation.

For clarity of the official record, this claim appears to define "a physical system" represented by a "model of a physical system." The model of a physical system is "discretized ... into a plurality of volumetric cells." Each volumetric cell is "modeled as a node" with "connections between the nodes." The nodes and connections are modeled by "facility instances and member variable instances of a class hierarchy." The claim then presents several limitations directed to the nature of that class hierarchy.

The "facility instances" and "member variable instances," which model the nodes which model the volumetric cells which are the result of "discretization" of a model representing a physical system, are created from facility types represented by a first set of generic classes and member variables represented by a second set of generic classes, respectively.

The hierarchy does not prevent the addition of additional facility types (represented by a first set of generic classes and used to create facility instances) and additional member variables (represented by a second set of generic classes and used to create member variable instances)

without any modifications to the hierarchy itself. Applicants' apparent definition of "modifying the hierarchy" appears to contradict what is conventional and known in the art. Adding something to a hierarchy modifies the hierarchy. Adding a child to a family tree modifies the family tree and adding a new class to a software class hierarchy modifies the hierarchy. The claim language does not, however, require "adding additional facility types". This language suffers additional deficiencies under 35 U.S.C. § 112, 1st paragraph, as described below. It is unknown what is meant by this language and therefore, for the purposes of examination, the claim is interpreted without this phrase.

> Claim 16. A computer implemented method of modeling [sic, *"managing"*] a hydrocarbon system comprising:
>
> Accessing an application on a computer system having a first set of generic classes and a second set of generic classes associated in a class hierarchy;
>
> Providing facility types for a hydrocarbon facility network created from the first set of generic classes;
>
> Providing member variables that are associated with at least one of the facility types and created from the second set of generic classes, wherein the facility types and the member variables do not modify the class hierarchy of the first set of generic classes and the second set of generic classes [*i.e., the facility types and member variables do not act upon the class hierarchy to modify it*];

Simulating transport phenomena in the hydrocarbon facility network with facility instances created from the facility types and the member variables instances created from the member variables; and

Evaluating the results of the simulation to manage operation of the hydrocarbon system [sic, *presumably the "hydrocarbon facility network" is somehow related to the "hydrocarbon system"*].

The rationale for the interpretation of claim 16 is deemed to be evident from the foregoing discussion.

Claim 24. A reservoir modeling system comprising a computer-readable medium encoded with instructions, the instructions configured to:

Provide a first set of generic classes and a second set of generic classes associated in a class hierarchy;

Access facility types created from the first set of generic classes;

Access member variables created from the second set of generic classes that are associated with at least one of the facility types, wherein the facility types and the member variables do not modify the class hierarchy of the first set of generic classes and the second set of generic classes [*i.e., the facility types and member variables do not act upon the class hierarchy to modify it*];

Create a hydrocarbon facility network [sic, *"model of" or "simulation of" a hydrocarbon facility network*] with facility instances created from the facility types and the member variables instances created from the member variables;

Simulate fluid flow in the hydrocarbon facility network; and

Display the simulation results [*for evaluation of the hydrocarbon facility network*].

The phrase "for evaluation of the hydrocarbon facility network" is a statement of intended use. Where the prior art "displays the simulation results," this is sufficient to anticipate the entire limitation.

The issues of patentability under 35 U.S.C. §§ 102 and 103 will be directed toward these interpretations of the claims. To distinguish the claimed invention over the prior art, Applicants must either persuasively argue that the claim interpretation is somehow improper and persuasively argue that the proper interpretation is distinguishable over the prior art, or must persuasively argue that the claim interpretation given above is distinguishable over the prior art.

Claim Rejections - 35 USC § 101

35 U.S.C. § 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. Claims 1-9 are rejected under 35 U.S.C. § 101 because the claimed invention is directed to non-statutory subject matter.

Claims 1-9 are directed to "a computer system comprising an object-oriented software product." None of the limitations require, expressly or implicitly, a tangible computer apparatus. Therefore these claims are directed to computer software *per se* and are nonstatutory.

The previous rejections under 35 U.S.C. § 101 of claims 10-13 and 16-22 have been withdrawn in response to the amendments to the claims. Applicants' arguments regarding these rejections have been fully considered.

To expedite a complete examination of the instant application the claims rejected under 35 U.S.C. § 101 (nonstatutory) above are further rejected as set forth below in anticipation of applicant amending these claims to place them within the four statutory categories of invention.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. § 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 1-9 and 13 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

MPEP 2164.01(a) lists several factors that can contribute to the determination whether experimentation is "undue". These factors include, but are not limited to:

- The state of the prior art;
- The nature of the invention;
- The level of one of ordinary skill;
- The existence of working examples; and
- The quantity of experimentation needed to make or use the invention based on the content of the disclosure.

The limitation of "the extensible class hierarchy permitting the addition of additional object types and additional member variables without any modifications to the class hierarchy itself" prevents a person of ordinary skill in the art from making and using the invention. The state of the prior art is such that existing programming languages that support object-oriented programming by various implementations define a class hierarchy according to the class types. The class hierarchy is a representation of the existing object types. The addition of new object types to the hierarchy, through inheritance, derivation, or some other equivalent, necessarily changes that class hierarchy. Evidence of working examples of programming languages that exhibit the claimed behavior would be appreciated.

The nature of the invention appears to be a means for simulating transport phenomena such as extracting oil from a subterranean hydrocarbon-bearing reservoir, not directly related to programming language design. In order to make and use the invention as claimed, a person of ordinary skill in the art would be required to invent an undisclosed programming language that facilitates this particular behavior, an endeavor unrelated to "simulating transport phenomena".

The act of designing computer programming languages is highly complex, undertaken almost exclusively by highly educated experts in that specific field, and often requires a

prohibitive investment in time and money. Programming languages such as Ada have gone through numerous versions throughout the years, and can be referred to as Ada95 (1995), Ada83 (1983), and so on.

As a result of these considerations, undue experimentation would be required to make and use the claimed invention wherein "the extensible class hierarchy" would permit "the addition of additional object types and additional member variables without any modifications to the class hierarchy itself".

Claims rejected but not specifically mentioned stand rejected by virtue of their dependence. Claim 13 reiterates the limitation discussed above.

Applicants have previously traversed this rejection, however those arguments were found unpersuasive. In the submission of 15 May 2006, Applicants argue primarily that:

> Applicants again submit that the present application complies with the current, well-established legal principals related to enablement and that the Examiner has not satisfied the requirements set forth within the M.P.E.P. § 2164.01(a) for establishing an enablement rejection for at least the reasons presented in the previous response. However, to further prosecution, Applicants have included a Declaration from Stephen Netemeyer (herein referred to as "Declaration") to further support that the current application is adequately enabling, which is attached as an Exhibit. In the Declaration, Mr. Netemeyer establishes that the specification and figures are sufficiently descriptive so as to enable one of ordinary skill in the art to make and/or use the invention. In particular, the Declaration includes a statement by Mr. Netemeyer that he is a person of ordinary skill in the art. Exhibit, para. 4. Mr. Netemeyer has acknowledged that the test for enablement is set forth as being whether one of ordinary skill in the art could make or use the invention from the disclosure in the patent coupled with information known in the art without undue experimentation. *See id.* at paras. 5 and 6. In view of this test, Mr. Netemeyer states that the current specification is sufficiently description so as to enable one skilled in the art to make and/or use the invention. *See id.* at para. 7. These statements are clearly supported by at least the portions of the specification cited by Mr. Netemeyer.

The Examiner respectfully traverses this argument as follows.

The Examiner has reviewed the Declaration from Mr. Netemeyer, **named inventor in this patent application**.

The test for enablement is whether a *hypothetical* person of ordinary skill in the art would find the disclosure enabling. As a **named inventor** in this application, it stands to reason that Mr. Netemeyer has 1) *surpassed* the level of ordinary skill in the art by virtue of his position as an inventor, 2) has *prior knowledge* of the invention being disclosed, and 3) has *prior knowledge* of the terminology, interpretations, intentions, and assumptions of the inventors. For these reasons, the Examiner finds that the Declaration does not overcome the rejections under 35 U.S.C. § 112, first paragraph.

The Examiner has reviewed the portions of the specification cited in the Declaration. None of this, however, explains how a person should make and/or use an "extensible class hierarchy permitting the addition of additional object types and additional member variables without any modifications to the class hierarchy itself" as recited by the claim. The Examiner maintains that in the technology of computer programming languages, adding something to a hierarchy modifies the hierarchy. Adding a child to a family tree modifies the family tree and adding a new class to a software class hierarchy modifies the hierarchy.

Applicants' arguments have been fully considered but have been found unpersuasive.

The following is a quotation of the second paragraph of 35 U.S.C. § 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

The previous rejections of claims 10-12 and 18 under 35 U.S.C. § 112, second paragraph, are withdrawn in response to Applicants' remarks and amendments.

5. Claim 21 is rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The meaning of the phrase "the member variables are be accessed without being having to be coded as part of the application" is unknown.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1-5, 8, and 9 are rejected under 35 U.S.C. § 102(b) as being anticipated by "The C++ Programming Language, Third Edition" by Bjarne Stroustrup (1997).

Regarding claim 1, Stroustrup discloses a computer system comprising an object-oriented software product (entire document, ex. page 732, section 24.2.5),

the software product containing an object-oriented extensible class hierarchy for the storage of data (entire document, ex. page 732, section 24.2.5; page 736, class "Car" storing "eptr" data),

the class hierarchy comprising a first set of generic classes representing a plurality of object types (page 735, "Vehicle," "Car," "Emergency," etc.)

and a second set of generic classes representing member variables for the object types (page 736, in "Police_car" constructor of class "Police_car", member variable "eptr" represented by class "Emergency").

In response, Applicants primarily argue that:

> For example, Stroustrup fails to disclose an "extensible class hierarchy permitting the addition of additional object types and additional member variables without any modifications to the class hierarchy itself," as recited in claim 1.

The Examiner respectfully traverses this argument as follows.

The claim language does not require "the addition of additional object types and additional member variables without any modifications to the class hierarchy itself." The claim requires **permitting** this step. Applicants have not argued that Stroustrup **forbids** this behavior, merely that it is not disclosed. This argument is unpersuasive because it does not show that Stroustrup fails to anticipate the claim language.

Applicants' arguments have been fully considered but have been found unpersuasive.

Regarding claim 2, which recites that "the transport phenomena comprises one or more of momentum, energy, and mass transport within a subsurface hydrocarbon-bearing reservoir and between the subsurface hydrocarbon-bearing reservoir and one or more delivery locations at the earth's surface," this language limits claim 1 only **indirectly**. Claim 1 recites storing "transport phenomena simulation data." The limitations of claim 2 further limit the type of "transport phenomena," but does not limit the structure or functionality of the system of claim 1.

Therefore, as Stroustrup anticipates claim 1, Stroustrup similarly anticipates claim 2 by disclosing, *inter alia*, storing data (entire document, ex. page 732, section 24.2.5; page 736, class "Car" storing "eptr" data).

In response to the previous rejection of claim 2, Applicants argue primarily that:

> [T]he Rahon and Stroustrup references fail to disclose claimed subject matter, such as "wherein the transport phenomena comprises one or more of momentum, energy, and mass transport within a subsurface hydrocarbon-bearing reservoir and between the subsurface hydrocarbon-bearing reservoir and one or more delivery locations at the earth's surface," as recited in claim 2...

The Examiner respectfully traverses this argument as follows.

For the reasons set forth above, the claim language referred to by Applicants only limits the scope of claim 1 indirectly and insufficiently to overcome the Stroustrup reference. It matters not if the data is energy data, mass data, color data, or poetry data. The system of claim 1 will store the data by the same mechanisms regardless of the source, context, or type of data being stored.

Applicants' arguments have been fully considered but have been found unpersuasive.

Regarding claim 3, which recites that "the transport phenomena between a subsurface hydrocarbon-bearing reservoir and one or more of the delivery locations comprises one or more pathways, the transport pathways comprising at least one of production and injection well types and one or more facility types that are linked together to form a facility network through which hydrocarbon fluids are transported between the subsurface reservoir and the delivery locations," this language limits claims 1 and 2 only **indirectly**. This claim appears to be directed to

"transport phenomena," which similarly to claim 2 does not limit the functionality or structure of the system of claim 1.

Therefore, as Stroustrup anticipates claims 1 and 2, Stroustrup similarly anticipates claim 3.

In response to the previous rejection of claim 3, Applicants argue primarily that:

> [The Rahon and Stroustrup references fail to disclose] "wherein the transport phenomena between a subsurface hydrocarbon-bearing reservoir and one or more of the delivery locations comprises one or more pathways, the transport pathways comprising at least one of production and injection well types and one or more facility types that are linked together to form a facility network through which hydrocarbon fluids are transported between the subsurface reservoir and the delivery locations," as recited in claim 3...

The Examiner respectfully traverses this argument as follows.

For the reasons set forth above, the claim language referred to by Applicants only limits the scope of claims 1 and 2 indirectly and insufficiently to overcome the Stroustrup reference.

Regarding claim 4, which recites "wherein the facility types contained within the transport pathways comprise at least one facility selected from surface flowlines, manifolds, separators, valves, pumps, and compressors," this language limits claims 1-3 only **indirectly**.

Therefore, as Stroustrup anticipates claims 1-3, Stroustrup similarly anticipates claim 4.

In response to the previous rejection of claim 4, Applicants argue primarily that:

> [The Rahon and Stroustrup references fail to disclose] "wherein the facility types contained within the transport pathways comprise at least one facility selected from surface flowlines, manifolds, separators, valves, pumps, and compressors," as recited in claim 4...

The Examiner respectfully traverses this argument as follows.

For the reasons set forth above, the claim language referred to by Applicants only limits the scope of claims 1-3 indirectly and insufficiently to overcome the Stroustrup reference.

Regarding claim 5, which recites "wherein a text file (Data Definitions File) contains the definitions of the possible facility types that can be included in a simulation model and the definitions of the possible member variables types for each facility type," this claim language appears to be entirely unrelated to the previously claimed invention. The language "wherein a text file contains" appears to be directed to nonstatutory nonfunctional descriptive material, such as software documentation or software code that merely contains a textual description of, perhaps, an aspect of the invention. This language refers to the "possible facility types," and therefore appears to exclude the "impossible facility types," but it is unknown how to identify one from the other. This language refers to possible facility types "that can be included in a simulation model," and therefore appears to exclude the possible facility types "that cannot be included in a simulation model," but it is unknown how to identify one from the other.

Of course, this claim language does not require including facility types in a simulation model, but instead merely requires the existence, somewhere, in some form, of a **text file** that contains the definitions (describes) **possible facility types** that, optionally, at any time in the past, present, or future, **can be included** in a simulation model. Similar analysis is appropriate for the language "possible member types for each facility type."

Stroustrup discloses a text file (page 225, section 10.2.2, "Date" class). Because Stroustrup also anticipates claims 1-4, in light of the claim language, this disclosure appears to fully anticipate the claim.

In response to the previous rejection of claim 5, Applicants submit that:

> [The Rahon and Stroustrup references fail to disclose] "wherein a text file (Data Definitions File) contains the definitions of the possible facility types that can be included in a simulation model and the definitions of the possible member variable types for each facility type," as recited by claim 5. Finally, the Examiner appears to have utilized hindsight reconstruction to pick and choose among isolated disclosures to teach the claimed subject matter. Hence, the cited references, alone or in combination , does not disclose or suggest the claimed subject matter.

The Examiner respectfully traverses this argument as follows.

For the reasons set forth above, Stroustrup anticipates claim 5.

The Examiner respectfully submits that in a patent application presenting claims spanning the spectrum from "object-oriented software written in C++" (claim 8), to a text file (claim 5), to "simulating transport phenomena in a facility network that models facilities used in the production of hydrocarbons" (claim 10), to "transport between a subsurface hydrocarbon-bearing reservoir and one or more of the delivery locations comprises one or more transport pathways, the transport pathways comprising at least one of production and injection well types and one or more facility types that are linked together to form a facility network through which hydrocarbon fluids are transported between the subsurface reservoir and the delivery locations" (claim 3), any "picking and choosing among isolated disclosures" is the **direct and inevitable result** of the claim language.

Applicants may consider promoting an expeditious and thorough prosecution by presenting a cohesive set of claims that correspond to the substance and import of the disclosed inventive concept.

Applicants' arguments have been fully considered but have been found unpersuasive.

Regarding claim 8, Stroustrup discloses software written in C++ (pages 732-733).

Regarding claim 9, Stroustrup discloses a hierarchy of logically related data (page 735, either figure, corresponding implementation illustrated on page 736).

The Authoritative Dictionary of IEEE Standards Terms, Seventh Edition, provides the following definition relied upon for this rejection:

> **database** A collection of logically related data stored together in one or more computerized files.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. §102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 16-28 are rejected under 35 U.S.C. § 102(e) as being anticipated by US Patent No. 6,434,435 to Tubel et al. (Tubel).

Regarding claim 16, Tubel discloses:

A computer implemented method of modeling a hydrocarbon system [*"The present invention further relates to oilfield hydrocarbon production management systems capable of managing hydrocarbon production from boreholes."* (column 1, lines 31-51)] comprising:

Accessing an application on a computer system having a first set of generic classes and a second set of generic classes associated in a class hierarchy [*"[T]he present*

invention relates to adaptive optimization software system which comprise intelligent software objects (hereinafter "ISO") arranged in a hierarchical relationship whereby the goal seeking behavior of each ISO can be modified by ISOs higher in the ISO's hierarchical structure. In yet further particularity, the present invention relates to ISOs comprising internal software objects including expert system objects, adaptive models objects, optimizer objects, predictor objects, sensor objects, and communication translation objects." (column 1, lines 14-30); Tubel discloses at least a first and second set of generic classes];

Providing facility types for a hydrocarbon facility network created from the first set of generic classes [*"Each ISO 10 can represent and model physical things..."* (column 7, lines 30-54); ***"The present invention's adaptive, object-oriented optimization software's user interface, more fully described herein below, initially presents a user with an initial set of ISO 10 internal software objects; user then configure specific ISOs 10 or groups of ISOs 10 from this initial set of possible internal software objects to represent, model, and relate ISO 10 to processes, concrete components (e.g., an automobile) or abstract components (e.g. a miles per gallon calculation) to represent real life or abstract processes such as plants, procedures, ideas, or systems. Mechanical devices, electrical devices, controllable processes, abstract calculations, or almost anything to be controlled or optimized can be represented by ISO 10."*** (column 7, line 58 – column 8, line 3, emphasis added); ***"Referring now to FIG. 30, a diagrammatic representation of ISOs 10 in flow and hierarchical relationships, ISOs 10 can model and represent any device or group of***

devices including sensors 200, controllable devices 300, fluid processing devices 400, injection devices 500, or any combination thereof. ISOs 10 can also model and represent more abstract processes such as a single zone like 640a, a group of zones such as 640a and 640b, an entire well such as well 640, or an entire field such as wells 640, 641, and 642." (column 25, lines 23-40, emphasis added)];

Providing member variables that are associated with at least one of the facility types and created from the second set of generic classes [*"Expert system objects 12 can "remember" by storing data regarding their own operation. These data may be accessible to other internal software objects in the same ISO 10 as the expert system objects 12 or to other ISOs 10, but may not be directly accessible by the user."* (column 8, lines 18-24)],

Wherein the facility types and the member variables do not modify the class hierarchy of the first set of generic classes and the second set of generic classes [Whether or not Tubel discloses this capability, Tubel does not disclose that facility types and member variables **<u>are required to modify the class hierarchy</u>**];

Simulating transport phenomena in the hydrocarbon facility network with the facility instances created from the facility types and the member variables instances created from the member variables [*"Further, ISO 10, using sensor objects' 25 data, predictor objects 18 and adaptive models objects 20,* ***can also simulate and/or predict future process performance*** *as well as determine the effectiveness of ISO's 10 modeling of future process performance."* (column 12, lines 6-30, emphasis added)]; and

Evaluating the result of the simulation to manage operation of the hydrocarbon system [*"Using these sensor objects 25, ISO's 10 expert system objects 12, predictor objects 18, adaptive models objects 20, and optimizer objects 22 work together to find, calculate, interpret, and derive new states for the control variables that result in the desired process state(s) or achieve the process goal(s)."* (column 7, lines 10-15)].

Regarding claim 24, Tubel discloses the limitations of analogous to those of claim 16 and further:

Simulate fluid flow in the hydrocarbon facility network [*"As described herein above, to accomplish tehse models and representations, two or more ISOs 10 may be configured in either flow relationships that model, or representationally correspond to,* ***the flow of the material*** *and/or information with is to be controlled, and/or hierarchical relationships that define the prioritization and scope relationships between ISOs 10 or groups of ISOs 10, e.g., between that which is being modeled."* (column 25, lines 23-40, emphasis added); *"Within ISO 610f, each of ISO 610d and 610e can concurrently be "flow" ISOs 10 as well, representing, for example,* ***the flow of hydrocarbons from each well into surface platform 645.****"* (column 25, lines 50-57, emphasis added)]; and

Display the simulation results for evaluation of the hydrocarbon facility network [*"Although human intervention may modify or override SCADA's 11 management of hydrocarbon production, SCADA's 11 ability to rapidly and adaptively react to complex and changing conditions affecting production with a minimum of human intervention allows SCADA 11 to automatically detect and adapt to varying control and*

communication reliability while still achieving its important control operations." (column 26, lines 15-25)].

Regarding claim 17, Tubel discloses wherein the simulation models fluid transport between a surface facility and a subsurface formation accessed by a well [*"Within ISO 610f, each of ISO 610d and 610e can concurrently be "flow" ISOs 10 as well, representing, for example, the flow of hydrocarbons from each well into surface platform 645."* (column 25, lines 50-57)].

Regarding claims 18, 25, and 26, Tubel discloses wherein the facility types comprise model representations of one or more of surface flowlines, manifolds, separators, valves, pumps, and compressors, which represent physical equipment in the flow path between a reservoir and a delivery location [*"Controllable devices 300 may include flow control devices familiar to those skilled in the hydrocarbon production arts and include valves, pumps, and the like."* (column 22, lines 8-38); (column 23, lines 8-41); *"Referring now to FIG. 30, a diagrammatic representation of ISOs 10 in flow and hierarchical relationships,* ***ISOs 10 can model and represent any device or group of devices including*** *sensors 200,* ***controllable devices 300****, fluid processing devices 400, injection devices 500, or any combination thereof. ISOs 10 can also model and represent more abstract processes such as a single zone like 640a, a group of zones such as 640a and 640b, an entire well such as well 640, or an entire field such as wells 640, 641, and 642."* (column 25, lines 23-40, emphasis added)].

Regarding claim 19, Tubel discloses wherein the simulation models fluid transport between surface facilities and a subsurface formation accessed by a plurality of wells [*"ISOs 10 can also model and represent more abstract processes such as a single zone like 640a, a group of zones such as 640a and 640b, an entire well such as well 640, or an entire field such as wells 640, 641, and 642."* (column 25, lines 23-40)].

Regarding claim 20, Tubel discloses coding the first set of generic classes representing the facility types and the second set of generic classes representing member variables prior to loading the application onto the computer system [*"The present invention's adaptive, object-oriented optimization software's user interface, more fully described herein below, initially presents a user with an initial set of ISO 10 internal software objects; user then configure specific ISOs 10 or groups of ISOs 10 from this initial set of possible internal software objects to represent, model, and relate ISO 10 to processes, concrete components (e.g., an automobile) or abstract components (e.g. a miles per gallon calculation) to represent real life or abstract processes such as plants, procedures, ideas, or systems. Mechanical devices, electrical devices, controllable processes, abstract calculations, or almost anything to be controlled or optimized can be represented by ISO 10."* (column 7, line 58 – column 8, line 3, emphasis added)].

Regarding claims 21 and 28 Tubel discloses using a text file configured to define the facility types and the member variables for use in the simulation, wherein the text file contains descriptive text and facility types, and instruction configured to access a descriptive text file that defines at least one of the facility types and member variables for use in the simulation [*"ISOs*

10 comprise internal software objects; in the preferred embodiment, the present invention uses a software programming methodology known as object-oriented programming, typically implemented using a computer language such as SmallTalk™ or C++, to implement the ISO's 10 internal software objects, thus creating an adaptive, object-oriented optimization software system." (column 6, lines 53-59); regarding simulation, *"Further, ISO 10, using sensor objects' 25 data, predictor objects 18 and adaptive models objects 20,* ***can also simulate and/or predict future process performance*** *as well as determine the effectiveness of ISO's 10 modeling of future process performance."* (column 12, lines 6-30, emphasis added)];

Regarding claims 22, 23, and 27, Tubel discloses creating facility instances from the facility types, utilizing the facility instances to represent components of the hydrocarbon facility network for the simulation, and managing the hydrocarbon system based on the simulation, and constructing logic that dynamically controls the behavior of facilities in the hydrocarbon facility network during a simulation run [*"The present invention's adaptive, object-oriented optimization software's user interface, more fully described herein below, initially presents a user with an initial set of ISO 10 internal software objects; user then configure specific ISOs 10 or groups of ISOs 10 from this initial set of possible internal software objects to represent, model, and relate ISO 10 to processes, concrete components (e.g., an automobile) or abstract components (e.g. a miles per gallon calculation) to represent real life or abstract processes such as plants, procedures, ideas, or systems. Mechanical devices, electrical devices, controllable processes, abstract calculations, or almost anything to be controlled or optimized can be represented by ISO 10."* (column 7, line 58 – column 8, line 3, emphasis added)].

Claim Rejections - 35 USC § 103

The previous rejections of claims 16-22 under 35 U.S.C. § 103 have been withdrawn in light of Applicants' remarks and amendments. Applicants' arguments directed to those rejections have been fully considered but are moot in light of the new grounds of rejection.

The following is a quotation of 35 U.S.C. § 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. § 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. § 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later

invention was made in order for the examiner to consider the applicability of 35 U.S.C. § 103(c) and potential 35 U.S.C. § 102(e), (f) or (g) prior art under 35 U.S.C. § 103(a).

8. Claims 6 and 7 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Stroustrup as applied to claim 1 above, and further in view of US Patent No. 6,842,725 to Sarda.

Regarding claim 6, Stroustrup discloses the limitations of claim 1.

Stroustrup does not expressly teach the graphical user interface.

Sarda teaches a method for modeling fluid flows in a hydrocarbon reservoir (column 2, lines 5-18). Sarda teaches a user interface wherein a user defines the specific well network for the reservoir [detailed description, section 5, "Simulation input data", *"The data relative to the well are: its geometry, in the form of a series of connected segments*[, and] *the imposed flow rates, in the form of a curve giving the imposed flow rate as a function of time."* (column 8, lines 28; 53-59)]. Sarda teaches a graphical interface concerning the well [*"A well is a series of connected segments that intersect the network fractures. The geometric representation of a well is therefore a 3D broken line."* (column 5, lines 60-63)]. Sarda both suggests and implies the use of a graphical user interface for defining the specific network of wells and facility objects to simulate transport phenomena into and out of a specific hydrocarbon-bearing reservoir.

Regarding claim 7, Sarda discloses a graphical user interface (column 5, lines 60-63). Sarda does not expressly forbid "a user of the computer [from defining] the additional member variables that extend the functionality of the computer system in a user-customizable manner."

Sarda and Stroustrup are analogous art because both are drawn to computer software.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine a graphical user interface as taught by Sarda with the programming language of Stroustrup by implementing a graphical user interface using a programming language.

The motivation for doing so is expressly found in Sarda [*"The main advantage of the method according to the invention in relation to methods applied to a finely meshed real fracture network lies, as detailed in the description hereafter, in a considerable reduction in a number of meshes centered on fracture nodes used to solve equation (1). The simulation rate saving in relation to prior fine-mesh methods can be confirmed to be greater than the simple arithmetical ratio of the number of meshes used in both cases."* (column 3, lines 22-30)] as well as expressly found in Stroustrup, such as an enhanced ability to understand how the model works [*"The point about modeling reality is not to slavishly follow what we see but rather to use it as a starting point for design, a source of inspiration, and an anchor to hold on to when the intangible nature of software threatens to overcome our ability to understand our programs."* (page 734)].

Therefore, it would have been obvious to combine Sarda with Stroustrup to obtain the invention as specified in claims 6 and 7.

9. Claim 7 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Stroustrup as applied to claim 1 above, and further in view of "Design Patterns: Elements of Reusable Object-Oriented Software" by Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides (Vlissides, 1995).

Regarding claim 7, Stroustrup does not expressly teach a graphical user interface through which a user can define additional data members.

Vlissides teaches a design pattern for object-oriented software called the "Factory Method" (page 107) wherein an exemplary use is shown (page 107) depicting, in flowchart form, a user interface wherein a user of a computer system can create additional data objects (*Documents*) by using a graphical user interface. Vlissides shows an exemplary "user customized" data member [*MyApplication*] that contains its own user-customized *CreateDocument()* member function.

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine the Factory Method design pattern taught by Vlissides, especially in light of Vlissides' examples, with the object-oriented programming language taught by Stroustrup to achieve a graphical user interface through which a user can define additional data members. The combination could be achieved by using a user-customized *CreateFacility()* function, wherein the nature of the problem to be solved would motivate a person of ordinary skill in the art to customize that function to the particular intended use at hand. Motivation to combine is expressly taught by Vlissides [*"Use the Factory Method pattern when: a class can't anticipate the class of objects it must create; a class wants its subclasses to specify the objects it creates; classes delegate responsibility to one of several helper subclasses, and you want to localize the knowledge of which helper subclass is the delegate."* (page 108) All these reasons relate directly to customization of the classes at a later point in time.].

10. Claims 10-12 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Sarda in view of Stroustrup.

Regarding claim 10, Sarda teaches a method for modeling fluid flows in a hydrocarbon reservoir (column 2, lines 5-18) including a facility network [*"A well is a series of connected segments that intersect the network fractures. The geometric representation of a well is therefore a 3D broken line."* (column 5, lines 60-63)]. Sarda teaches a user interface wherein user specifies values of the member variables for each facility [detailed description, section 5, "Simulation input data", *"The data relative to the well are: its geometry, in the form of a series of connected segments*[, and] *the imposed flow rates, in the form of a curve giving the imposed flow rate as a function of time."* (column 8, lines 28; 53-59)]. Sarda teaches using the specified values in a mathematical simulation of transport phenomena within the facility network as a function of time, thereby predicting the behavior of the facilities based on the simulation [*"In order to simulate a well test, whatever the medium, this equation has to be solved in space and in time. Discretization of the reservoir (mesh pattern) is therefore performed and solution of the problem consists in finding the pressures of the meshes with time, itself discretized in a certain number of time intervals."* (column 2, lines 24-47)].

Sarda does not explicitly disclose the software design of the method for modeling fluid flows.

Stroustrup discloses "building a model comprising a facility network [...] formed from facility types based on a first set of generic classes and member variable instances formed from member variables for the facility types based on a second set of generic classes, and wherein the first set and second set of generic classes are part of a class hierarchy that is not modified by the

addition of other facility types and member variables," (pages 735-738 and as cited above). This limitation refers to basic concepts of object-oriented programming. Whether or not a class hierarchy is modified at a later time is impossible to compare to the teachings of the prior art.

It would have been obvious to a person of ordinary skill in the art to implement the model taught by Sarda in object-oriented software because the advantages of object-oriented software are well known to persons of ordinary skill. Motivation to do so is explicitly taught by Stroustrup, such as an enhanced ability to understand how the model works [*"The point about modeling reality is not to slavishly follow what we see but rather to use it as a starting point for design, a source of inspiration, and an anchor to hold on to when the intangible nature of software threatens to overcome our ability to understand our programs."* (page 734)].

In response, Applicants argue primarily that:

> In Sarda, a method of modeling fluid flows in the fractured multilayer porous medium by accounting for the real geometry of the fracture network and the local exchanges with the porous matrix is described. (cit. omitted) Clearly, Sarda does not provide or teach building a model having a facility network, much less, predicting the behavior of the facilities based on the mathematical simulation.
>
> Stroustrup describes the C++ concepts for creating built-in types to organize classes and take advantage of the relationships. (cit. omitted) In particular, Stroustrup describes that inheritance may be utilized to represent the hierarchical relationships directly. (cit. omitted) While Stroustrup describes classes having subclasses, it does not describe "the first set and second set of generic classes are part of a class hierarchy that is not modified by the addition of other facility types and member variables," as recited in claim 10.

The Examiner respectfully traverses this argument as follows.

Applicants' arguments appear to misconstrue how the references have been applied. Sarda teaches a facility network, as cited, and Sarda teaches predicting the behavior of facilities based on a mathematical simulation, as cited.

Regarding Applicants' analysis of the Stroustrup reference, although it is disclosed that the class hierarchy **<u>may</u>** be modified, there is no requirement in the reference that the hierarchy

must be modified beyond what is shown. A person might, for example, acknowledge that the hierarchy **may** be further modified, but choose to use the hierarchy as disclosed by Stroustrup. As such, according to the plain meaning of the claim language, Stroustrup anticipates the recited feature.

Applicants' arguments have been fully considered but have been found unpersuasive.

Regarding claim 11, Sarda teaches that the facility network is part of a larger simulation model, with said facility network is configured to exchange fluids with at least one other part of the simulation model [fluid from the reservoir is transferred via the series of connected segments that form the facility network of the well (column 2, lines 55-67)].

Regarding claim 12, Sarda teaches that the simulation model comprises a facility network [*"A well is a series of connected segments that intersect the network fractures. The geometric representation of a well is therefore a 3D broken line."* (column 5, lines 60-63)] and a hydrocarbon-bearing formation [*"Discretization of the reservoir (mesh pattern) is therefore performed and solution of the problem consists in finding the pressures of the meshes with time, itself discretized in a certain number of time intervals."* (column 2, lines 43-47)].

11. Claim 13 is rejected under 35 U.S.C. § 103(a) as being unpatentable over US Patent No. 6,434,435 to Tubel et al. (Tubel) in view of Sarda, and further in view of Stroustrup.

Regarding claim 13, Tubel teaches an object-oriented software for control of a hydrocarbon production system (column 1, lines 14-50). Although Tubel is primarily concerned with the control of such a system, the disclosed invention can also perform in a simulation mode [*"...in the simulation mode, simulated and/or calculated sensor and actuator data may be used in place of data from real-world sensors and actuators. Simulation of real or abstract systems occurs by having an ISO 10 evaluate or interrogate a model of a real or abstract thing or system or evaluate and/or interact with rules associated with the real or abstract thing."* (column 12, lines 6-18)].

Tubel teaches a predicting the behavior of (and therefore simulating) a hydrocarbon-bearing reservoir penetrated by a plurality of wells and surface facilities, the plurality wells connected to surface facilities [*"...the present invention relates to management of hydrocarbon production from a single production well (e.g., only well 642) or from <u>a group of wells, shown in FIG. 28 as well 640, well 641, and well 642</u>.*" (column 23, lines 8-15); *"Referring still to FIG. 28, as is well known in the art a given well may be divided into a plurality of separate zones, such as zone 640a, zone 640b, and zone 640c. Such zones may be positioned in a single vertical well such as well 640 <u>associated with surface platform 645</u>, or such zones may result when <u>multiple wells are linked or otherwise joined together</u> (not shown in FIG. 28)."* (column 26, lines 52-58, emphasis added)].

Tubel teaches using objects and variables in a class hierarchy to model the wells and surface facilities [*"Referring now to FIG. 30, a diagrammatic representation of ISOs 10 in flow and hierarchical relationships, ISOs 10 can model and represent any device or group of devices including sensors 200, controllable devices 300, fluid processing devices 400, injection devices*

500, or any combination thereof. ISOs 10 can also model and represent more abstract processes such as a single zone like 640a, a group of zones such as 640 a and 640b, an entire well such as well 640, or an entire field such as wells 640, 641, and 642." (column 25, lines 23-31)].

Tubel does not teach discretizing the reservoir into a plurality of volumetric cells, each modeled as nodes, and simulating the exchange of fluid between those nodes.

Sarda teaches discretizing the reservoir into a mesh pattern (consisting of interconnected nodes) used to model the reservoir by finding the pressure of the oil contained therein as a function of time (column 2, lines 24-47). In this method, the model simulates the flow of fluid through a porous medium, accounting for the real geometry of the fracture network (found in the reservoir) and thus simulates the interactions between the pressure and flow rate variations in a well running across the medium (column 2, lines 55-67). Sarda teaches specifying initial conditions for each node and connection (column 4, lines 33-64).

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine Sarda's method for modeling the flow of fluid in a reservoir with Tubel's object-oriented method of modeling a facility network. The combination could be achieved by operating Tubel's method in simulation mode, wherein the data calculating the transport phenomena of the underground reservoir is supplied by Sarda's method and delivered to the sensors and actuators modeled by Tubel. Motivation to combine would be found in the knowledge of a person of ordinary skill in the art as well as the nature of the problem to be solved; Tubel's simulation mode requires calculated sensor and actuator data while the results of Sarda's model provide an efficient and accurate representation of the transport phenomena that would be detected by Tubel's sensors.

Tubel in view of Sarda does not explicitly teach the claimed software object hierarchy.

Stroustrup discloses a computer programming language that implicitly discloses the use of a modern computer system comprising memory means, storage means, and software created using the C++ programming language.

Stroustrup discloses a class hierarchy (page 735, either figure) comprising a first set of generic classes representing a plurality of object types (example: *Car* or *Truck*) and a second set of generic classes representing member variables for the object types [*"The 'plain' cars and trucks are initialized with **Vehicle::eptr** zero; the others are initialized with **Vehicle::eptr** nonzero."* (page 736) Also, example: *Police_car*, class definition of *Police_car*] and wherein the hierarchy is designed to be expanded as necessary [section 24.3.2.1 Dependencies within a Class Hierarchy; *"If, however, the intent is to provide a framework into which a later programmer can add code, then virtual functions are often an elegant mechanism for achieving this..."* (page 738)].

It would have been obvious to a person of ordinary skill in the art at the time of Applicants' invention to combine Tubel in view of Sarda with the class hierarchy capable of storing data as taught by Stroustrup. The combination could be achieved by representing the volumetric cells of Tubel in view of Sarda as the objects (storing the appropriate simulation data) and methods of a class hierarchy as taught by Stroustrup. Motivation to do so is explicitly taught by Stroustrup, such as an enhanced ability to understand how the model works [*"The point about modeling reality is not to slavishly follow what we see but rather to use it as a starting point for design, a source of inspiration, and an anchor to hold on to when the intangible nature of software threatens to overcome our ability to understand our programs."* (page 734)].

In response, Applicants argue primarily that:

> Tubel and Sarda fail to disclose "using facility instances and member variable instances of a class hierarchy to model the nodes and connections in the portion of the discretized model that represents wells and surface facilities of the physical system, wherein the class hierarchy comprises a first set of generic classes representing facility types utilized to create the facility instances and a second set of generic classes representing the member variables for the facility types utilized to create the member variable instances, the class hierarchy permitting the addition of additional facility types and additional member variables without any modifications to the class hierarchy itself," as recited in claim 13...
>
> Indeed, Tubel describes changing the class hierarchy. Similarly, as discussed above, Sarda reference discloses the modeling of a well test in a fractured reservoir.
>
> [Arguments directed to the Stroustrup reference are reiterated.]

The Examiner respectfully traverses this argument as follows.

Applicants' observation that Tubel describes changing the class hierarchy is noted. The claim language does not exclude changing the class hierarchy. The claim language requires **permitting** the addition of facility types and member variables without modifications to the hierarchy. The simple fact that Tubel describes changing the class hierarchy is not evidence that Tubel **forbids** the addition of facility types and member variables without modifications to the hierarchy.

Applicants' arguments regarding the Sarda and Stroustrup reference have been addressed above.

Applicants' arguments have been fully considered but have been found unpersuasive.

Conclusion

Art considered pertinent by the examiner but not applied has been cited on form PTO-892.

US Patent No. 6,052,520 to Watts, III, shares a common assignee with the instant application and discloses subject matter related to the simulation of a hydrocarbon reservoir.

"Reservoir Simulation: Past, Present, and Future" by J.W. Watts, SPE, Exxon Production Research Company discloses a description of the state of the art in simulation of hydrocarbon reservoirs, circa 1997.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason Proctor whose telephone number is (571) 272-3713. The examiner can normally be reached on 8:30 am-4:30 pm M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Rodriguez can be reached at (571) 272-3753. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Any inquiry of a general nature or relating to the status of this application should be directed to the TC 2100 Group receptionist: 571-272-2100. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jason Proctor
Examiner
Art Unit 2123

jsp

PAUL RODRIGUEZ
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100

7/24/06